(12) UK Patent Application (19) GB (11) 2 002 222 A

(21) Application No 7832861
(22) Date of filing 10 Aug 1978
(23) Claims filed 10 Aug 1978
(30) Priority data
(31) 52/097140
(32) 13 Aug 1977
(33) Japan(JP)
(43) Application published
21 Feb 1979

(54) **Process for treating wheat flour and treated wheat flour**

(57) The properties of wheat flour for baking cakes are improved by adding to the wheat flour at least one of acetic acid, propionic acid and ethyl alcohol and then subjecting it to storage and/or

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SPECIFICATION NO 2002222A

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Page 6, line 7, *for* harffwheat *read* hard wheat

THE PATENT OFFICE
22 August 1979
Shibuya-ku.

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SPECIFICATION NO 2002222 A

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Page 3, line 55, *after* of *delete* propionic *insert* acetic acid

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THE PATENT OFFICE
9 June 1980

Bas 76742/13

GB 2 002 222 A

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(31) 52/097140
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(33) Japan(JP)
(43) Application published
21 Feb 1979
(51) INT CL²
A21D 2/14 6/00
(52) Domestic classification
A2Q 13 16B1 16B2 5A
(56) Documents cited
GB 907128
GB 300291
"Modern Cereal Chemistry" 6th Edition (1967) by Kent-Jones and Amos, Food Trade Press Ltd. London
Pp 175-178 and 301.
(58) Field of search
A2Q
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(54) Process for treating wheat flour and treated wheat flour

(57) The properties of wheat flour for baking cakes are improved by adding to the wheat flour at least one of acetic acid, propionic acid and ethyl alcohol and then subjecting it to storage and/or heating to improve its properties. This treatment is intended to replace natural aging of wheat flour.

GB 2 002 222 A

SPECIFICATION

Process for treating wheat flour and treated wheat flour

This invention relates to a process for treating wheat flour and treated wheat flour. More particularly, it relates to a process for aging wheat flour in a relatively shorter period of time than is conventional for natural aging.

To obtain wheat flour having excellent confectionary properties suitable for the use in the production of cakes and Japanese-style confections it has been considered necessary to subject the flour to a prolonged period of natural aging. In general, wheat flour is employed after it has been stored in a storage warehouse for a certain period of time following milling. This aging is required because the quality of wheat flour is not stable immediately after milling. Typically wheat flour for cakes and Japanese-style confections is aged for several months or more, and a storage period of 6 months to one year is considered necessary for natural aging of wheat flour for producing high quality cakes and Japanese-style confections. Aging has been regarded as indispensable to improve the confectionary properties of wheat flour, and thus to prevent "caving-in" of cakes after baking, generation of half-cooked layers in baked cakes, and wetness and watery taste in baked cases. Japanese-style confections using aged wheat flour have a delicate or soft texture in the mouth.

Many attempts have been made to replace the natural aging by promoting aging artifically. In these attempts, wheat flour has been treated with aging agents such as basic amino acids, higher alcohols having 8 to 16 carbon atoms and polyphosphate, ammonium persulphate, chlorine dioxide, and potassium bromate. However, these aging agents have not given a completely satisfactory product, or have left residues of used aging agents in the final product.

In published Japanese Patent Specification No. 51-29267, a method is described in which wheat flour is aged by maintaining it at a temperature of 40° to 70°C for a period of 2 to 20 days without a loss of moisture content. It is, however, difficult in an industrial process to store wheat flour at a constant high temperature for several days. U.S. Patent No. 3,490,917 discloses a method for producing wheat flour for cake which includes complex treatments such as the removal of gluten from a crude wheat flour. Thus, both these methods are technically awkward and troublesome, and are not suitable for widespread industrial application.

As can be seen from the above, no complete solution to the problem as to the replacement of natural aging has yet been found. We have carried out an extensive, careful study of storing methods with a view to improving the confectionary properties of wheat flour without natural aging, and we have established that the confectionary properties of wheat flour can be improved even when stored at room temperature by treating that wheat flour with at least one of acetic acid, propionic acid and ethyl alcohol. We have found that this treatment can be employed in place of natural aging, and, in addition, is relatively economical and easy to put into practice.

Accordingly, this invention provides a process for improving confectionary properties of wheat flour, which comprises adding to the wheat flour at least one of acetic acid, propionic acid and ethyl alcohol, and subsequently subjecting the wheat flour to storage and/or heating for a period sufficient to improve the confectionary properties thereof.

The process of the invention thus reacts components of wheat flour with at least one of acetic acid, propionic acid and ethyl alcohol, which are volatile, edible additives. Since the additive is volatile, it is distributed uniformly over and into wheat flour, and the flour components may react effectively and evenly with it. This is a remarkable feature of the invention. The reaction of components of wheat flour with an additive for improving the confectionary properties must proceed homogenously over and into wheat flour to the desirable extent if the product is to be uniform. By employing volatile additives the process of the invention may achieve the desired homogenous reactions for improving the wheat flour properties. Furthermore, it is quite feasible to remove any volatile additive remaining in the treated wheat flour, and this is a valuable feature of the process.

The addition of a volatile additive and subsequent treatment of the wheat flour together produce the improved properties of wheat flour components. It is well known that a wheat flour which is acidic is not suitable for producing cakes. Therefore, the process of this invention wherein a volatile and easily removable additive is employed is particularly advantageous.

It has been found that by employing heat treatment of the wheat flour after mixing it with the additive the above-mentioned improvements may be obtained in a relatively short time. However, the confectionary properties of wheat flour may be improved according to the invention by storing the wheat flour with additive at room temperature without heating. This gives a particularly economical process, and the period of time necessary for storing is significantly reduced as compared to natural aging. A combination of storage and heating may also be used.

The process of the invention may use any edible form of acetic acid produced by fermentation or by synthesis. For example, acetic acid may be employed as the acid itself or as vinegar. It is preferred for the process to employ glacial acetic acid in practice. Acetic acid may be added as such, or after diluting it with water. The acetic acid is preferably used at a rate of 0.02% to 0.5w/w%, expressed as the weight of acetic acid (contained in the acetic acid-containing liquid) per unit weight of wheat flour. A rate of 0.05% to 0.3% is preferred. Unless otherwise stated, all parts and percentages expressed hereinafter are by weight.

Propionic acid may be employed to treat wheat flour according to the invention, and suitable forms and preferred rates of propionic acid are selected on the same bases as set out above for acetic acid.

Ethyl alcohol may also be used to treat the wheat flour, and any edible kind of ethyl alcohol may be employed. Preferably ethyl alcohol is used at a rate of 2% to 30%, preferably 5% to 15%, by weight of wheat flour. It is advantageous to employ aqueous solutions containing 60% or more or ethyl alcohol.

If the volatile additives are used in amounts below the preferred ranges set our hereinbefore the improve-

ment on the properties of the wheat flour is small. By way of contrast, the addition of amounts above the preferred ranges does not result in any remarkably increased effect. In some cases, the addition of excessive amounts of the additive may adversely affect the properties of the treated wheat flour, for example by causing a deterioration in the flavour of cakes produced therefrom.

When a combination of the volatile additives is used, the total amount used preferably corresponds to the preferred amounts for the individual additives defined above. A suitable combination may be selected having regard to considerations of easy handling of the wheat flour and its intended use.

The volatile additives may be added to the wheat flour in undiluted form or after dilution with water. Most conveniently they are sprayed uniformly on to the wheat flour while this is agitated. Alternatively, the wheat flour may be contacted with a volatile additive as a vapour.

Following treatment with a volatile additive the wheat flour is then subjected to storage or to heating or a combination of storage and heating, or heating and storage.

The term "storage" as used herein refers to maintaining the wheat flour with the added volatile additive at or near room temperature for a sufficient period of time. The period of time for obtaining the desired effect depends *inter alia* on the kind of wheat flour used, its intended use, the volatile additive used, the amount of volatile additive added, the condition of the mixture and the temperature at which the mixture is maintained. For example, the process can be carried out by adding to the wheat flour an aqueous 94% solution of ethyl alcohol at a rate of 18% by weight of the wheat flour and then subjecting the resultant mixture to storage at 27°C for 6 hours, or by adding to the wheat flour an aqueous 20% solution of acetic acid at a rate of 2% by weight of the wheat flour and then subjecting the resultant misture to storage at 27°C for 5 days. The wheat flour/additive mixture may be suitably agitated during the storage. Since storage takes place at room temperature without any special heating means and the normal storage time until the flour is formulated into confections can be utilized, storage is both an inexpensive and practical treatment for the wheat flour.

The improvement in confectionary properties of the wheat flour is a phenomenon caused by chemical reactions between wheat flour components and the acetic acid, propionic acid or ethyl alcohol. Thus, when storage is carried out over a long period, the improvement can be achieved by storage at room temperature. If the desired improvement is required within a short period of time, the treated wheat flour may be heated. Heating to a temperature between room temperature and 100°C is sufficient for the object of this invention. It is a feature of the invention that the heating time can be shorter and the heating temperature can be lower, as compared with prior art methods for improving the properties of wheat flour for cake by heating. Preferred heating conditions for obtaining sufficient improvement in confectionary properties economically employ a temperature of from 70° to 90°C and a heating time of from 20 minutes to 3 hours. If desired, the mixture of wheat flour and additive can be stored for a period of time and thereafter heated, and in this case, the heating time can be shorter than when only a heat treatment is used. The heating temperature can also be lowered.

Heating promotes the reactions between the wheat flour components and the acetic acid, propionic acid, or ethyl alcohol additive. In addition, heating is effective in removing the volatile additive after the reaction is completed. When acetic acid or propionic acid still remains in wheat flour after the treatment, it can be neutralized with a basic material. To minimize the amount of acetic acid or propionic acid remaining, as well as the remaining ethyl alcohol, a treated wheat flour may be heated for a short period of time at a temperature within the range of from 100° to 150°C. Heating at a temperature within this range is most effective for vapourizing and diffusing acetic acid or propionic acid.

As propionic acid is effective for inhibiting mould growth, it is useful in storing treatments lasting several months. Acetic acid is more suitable for a short period of storage. However, if a long storage treatment is being used where acetic acid is the additive, the wheat flour should be stored in a hermetically-sealed container.

After storage of wheat flour treated with ethyl alcohol, the amount of ethyl alcohol remaining in the wheat flour is small. Thus, the initial amount of ethyl alcohol is preferably somewhat larger than the amounts of acetic acid or propionic acid used to treat the wheat flour.

When two or three of volatile additives are combined, having regard to these properties of the additives, the resulting combination may have remarkable effects in some circumstances. For example, in a preferred embodiment of the invention when an improvement in confectionary properties of wheat flour within a short period of time is required, the process may be carried out by spraying an aqueous 20% solution of acetic acid amounting to 0.07% by weight of the wheat flour and an aqueous 78% solution of ethyl alcohol amounting to 6% by weight of the wheat flour on to weak flour, and heating the resulting mixture to 70°C for 3 hours, or to 90°C for one hour. The wheat flour obtained has minimal amounts of remaining volatile additives and has excellent confectionary properties comparable with those of wheat flour naturally aged for a prolonged period of time.

Various types of apparatus may be employed for heating. As wheat flour has inherently a poor heat conductivity, heating is usually performed with a direct drier or an indirect drier. Indirect driers are generally perferred for use in the invention, and among them screw driers, agitated-pan driers and rotary driers are particularly preferred. Continuous operation or bath operation can be employed.

A heat treatment in accordance with this invention comprises heating the wheat flour before addition of an additive, adding the additive to the wheat flour while it is at a temperature above room temperature, and thereafter maintaining the wheat flour with additive at a temperature above room temperature. In this heat treatment, the additive can be added to the hot wheat flour during heating or after the completion of the heating.

Wheat flour improved according to the invention has excellent confectionary properties. For example, when it is used for making sponge cakes or butter cakes, the baked cakes are excellent insofar as they display substantially no cave-in after baking, no generation of half-cooked layers and no wet and watery taste when they are eaten.

The invention will now be described in more detail, thoughonly be way of illustration, in the following

Examples.

EXAMPLE 1

The process of this invention was investigated in the following tests.

The extent of improvement in the qualities of wheat flour was evaluated on the basis of the qualities of sponge cake made from the improved wheat flour. The results are shown in Table 2 below. Wheat flour which had been maintained at room temperature for 20 days after milling was employed and had the following analysis: moisture content, 12.2%; protein content, 6.7% and ash content, 0.33%.

The procedure for adding acetic acid, propionic acid or ethyl alcohol to the wheat flour comprised diluting a suitable liquid containing one of the additives with the appropriate pre-determined quantity of water and spraying the diluted solution on to agitated wheat flour by means of a spraying apparatus. When diluted, the aqueous solution of acetic acid or propionic acid had a concentration of 20%, whereas the aqueous solution of ethyl alcohol had a concentration of 80%. When the wheat flour was treated by storage this was carried out by allowing the wheat flour mixture to stand in a hermetically-sealed container at about 20°C for a pre-determined period. When the treatment involved heating, the wheat flour mixture was heated to the desired temperature with an agitated-pan drier.

A batter was produced from a recipe shown in Table 1 below by a conventional method. 250 g of the produced batter were poured into a round baking mould having an inner diameter of 15 cm and baked at about 170°C for about 30 minutes to obtain a sponge cake.

When the moisture content of wheat flour increased or decreased during storage, such an increase or a decrease was compensated so that the moisture content and solids content in a portion of treated wheat flour were equal to those in a portion of untreated wheat flour. When acetic acid or propionic acid were used to treat the wheat flour, sodium bicarbonate was thereafter added to the treated wheat flour in an amount equivalent to that of remaining acid after treatment.

As shown by Table 2, cakes made from a wheat flour improved according to this invention showed no cave-in and had an excellent eating quality. Thus, it is clearly shown that the treatment of this invention greatly improves the confectionary properties of wheat flour.

Table 1

Recipe of sponge cake

Wheat flour	100 parts
Egg	100 parts
Sugar	100 parts
Water	35 parts

Table 2

Test Results

Treatment	Volume (ml)	Degree of cave-in	Degree of wetness and wateriness	Half-cooked layers
Maintained at room temperature for 20 days after milling	596	++	++	++
Maintained at room temperature for 45 days after milling	602	++	++	++
Heated at 70°C for 30 minutes	565	++	+	+
Heated at 70°C for	564	++	+	+
0.1% of propionic added, immediately employed	641	++	+	− +
0.1% of propionic acid, added, immediately employed	643	++	+	− +

Treatment	Volume (ml)	Degree of cave-in	Degree of wetness and wateriness	Half-cooked layers
10% of ethyl alcohol added, immediately employed	625 +	–	+	+
0.1% of acetic acid added, employed after storing for 25 days	741	–	–	–
0.1% of acetic acid added, heated at 70°C for 30 minutes	701	–	–	–
0.1% of acetic acid added, stored for 7 days, then heated at 70°C for 30 minutes	723	–	–	–
0.1% of propionic acid added, stored for 25 days	733	–	–	–
0.1% of propionic acid added, heated at 70°C for 30 minutes	728	–	–	–
0.1% of propionic acid, added, stored for 7 days, then heated at 70°C for 30 minutes	735	–	–	–
10% of ethyl alcohol added, stored for 25 days	695	–	–	–
10% of ethyl alcohol added, heated at 70°C for 30 minutes	681	–	–	–
10% of ethyl alcohol added, stored for 7 days, then heated at 70°C for 30 minutes	690	–	–	–
0.05% of acetic acid and 0.05% of propionic acid added, heated at 70°C for 30 minutes	720	–	–	–
0.5% of acetic acid and 5% of ethyl alcohol added, stored for 7 days, then heated at 70°C for 30 minutes	697	–	–	–
0.05% of acetic acid, 0.05% of propionic acid and 5% of ethyl alcohol added, stored for 25 days	710	–	–	–

The rating of properties of sponge cake in the above Table is as follows:
Degree of cave-in: the degree of cave-in which took place after baking
++ ..... significantly sunken
+ ..... slightly sunken
- ..... not sunken
Degree of wetness and wateriness: state of sponge of cake when eaten
++ ..... significantly wet and watery
+ ..... slightly wet and watery
- ..... not wet or watery
Half-cooked layers: presence or absence of half-cooked layers in sponge of cake
++ ..... widely present
+ ..... locally present
- ..... absent

EXAMPLE 2

0.67 parts by weight of an aqueous 15% solution of acetic acid were sprayed uniformly on to 100 parts of agitated weak flour, which had been maintained at room temperature for 20 days after milling and had the following analysis: moisture content, 12.2%; protein content, 6.$; and ash content, 0.33%. The mixture was subjected to a storing treatment at about 25°C for 30 days to obtain a treated wheat flour.

Employing this treated wheat flour, a cake mix was prepared according to the following recipe:

To 345 g of the cake mix set out below 70 ml of water and two eggs were added, and the formed mixture was made into cakes by conventional procedures.

Cake mix recipe

Treated wheat flour	140 g
Sugar	140 g
Neopowder–A (from Nippon Oils and Fats Co.Ltd)	50 g
Emulsy–MM–100 (from Riken Vitamin Oil Co.Ltd.)	8 g
Sugar ester P–1570 (from Ryoto Co.Ltd.)	1 g
Table Salt	2 g
Powdered flavouring agent	1 g
Baking powder	4 g

Cakes having an excellent eating quality and no cave–in were obtained.

EXAMPLE 3

0.75 parts of an aqueous 40% solution of acetic acid were sprayed uniformly on to 100 parts of the same weak flour as used in Example 1, again with agitation. The mixture was subjected to a storing treatment at about 25°C for 10 days, and then the mixture was dried at 60°C for 2 hours by means of a hot–air drier to obtain a treated wheat flour.

Employing this treated wheat flour, a cake mix was prepared according to the following recipe:

To 337 g of the cake mix set out below were added 80 ml of water and two eggs, and the formed mixture was made into cakes by conventional procedures.

Cake mix recipe:

Treated wheat flour	132 g
Sugar	140 g
Neopowder–A (from Nippon Oils and Fats Co.Ltd.)	50 g
Emulsy–MM–100 (from Riken Vitamin Oil Co.Ltd.)	8 g
Sugar ester P–1570 (from Ryoto Co.Ltd.)	1 g
Table salt	2 g
Powdered flavouring agent	1 g
Baking powder	4 G

Cakes having an excellent eating quality and nocave-in were obtained.

EXAMPLE 4

10 parts of an aqueous 70% solution of ethyl alcohol were sprayed homogenously on to 100 parts of agitated weak flour which had previously been maintained at room temperature for 24 days after milling and had the following analysis: moisture content, 12.5%; protein content, 7.4%; and ash content, 0.35%. The

mixture was introduced in a polyethylene bag, the bag was hermetically sealed and stored at 20°C for 10 days. Thereafter, the mixture was heated to 80°C for 20 minutes by means of a drum drier to obtain a treated wheat flour.

EXAMPLE 5

1.0 part of an aqueous 20% solution of propionic acid was sprayed uniformly on to 100 parts of agitated harffwheat flour which had previously been maintained at room temperature for 18 days after milling and had the following analysis: moisture content, 13.6%; protein content, 12.1%; and ash content, 0.35%. Thereafter, the mixture was heated at 90°C for one hour by means of an agitated-pan drier to obtain a treated wheat flour.

With this treated wheat flour, a cake compound was prepared according to the following cake recipe, by conventional procedures:

Cake recipe

Treated wheat flour of this example	27 g
Treated wheat flour of Example 3	64 g
Sugar	100 g
Egg	100 g
Butter	100 g
Water	9 g

Cakes having an excellent eating quality and no cave-in were obtained.

EXAMPLE 6

An open vessel containing an aqueous 94% solution of ethyl alcohol was introduced in a closed container containing a mixture of 60 parts of weak flour, which had been maintained at room temperature for 20 days after milling and had the following analysis: moisture content, 13.1%; protein content, 7.1%; and ash content, 0.34%; and 40 parts of soft wheat flour which had been maintained at room temperature for 22 days and had the following analysis: moisture content, 12.8%; protein content, 9.5%; and ash content, 0.35%. The vapour of the ethyl alcohol contacted with the wheat flours. After storing at 20°C for 2 months, a treated wheat flour was obtained.

CLAIMS

1. A process for improving confectionary properties of wheat flour, which comprises adding to the wheat flour at least one of acetic acid, propionic acid and ethyl alcohol, and subsequently subjecting the wheat flour to storage and/or heating for a period sufficient to improve the confectionary properties thereof.

2. A process as claimed in Claim 1, in which there is added to the wheat flour acetic acid at a rate of 0.05% to 0.3% by weight of the wheat flour, propionic acid at a rate of 0.05% to 0.3% by weight of the wheat flour, or ethyl alcohol at a rate of 5% to 15% by weight of the wheat flour.

3. A process as claimed in Claim 1 or Claim 2, in which the wheat flour is subsequently heated to a temperature of from 70°C to 90°C and held at that temperature for from 20 minutes to 3 hours.

4. A process as claimed in Claim 1 and substantially as described herein with reference to any one of the Examples.

5. Wheat flour having improved confectionary properties prepared by a process as claimed in any of Claims 1 to 4.

6. Wheat flour as claimed in Claim 5, and substantially as described herein with reference to any one of the Examples.

Printed for Her Majesty's Stationery Office, by Croydon Printing Company Limited, Croydon Surrey, 1978.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.